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Hewitt-Dundas, N., & Roper, S. (2017). Innovation in UK higher education: A panel data analysis of undergraduate degree programmes. *Research Policy*, *47*(1), 121. https://doi.org/10.1016/j.respol.2017.10.003

Published in:
Research Policy

Document Version:
Peer reviewed version

Innovation in UK higher education: A panel data analysis of undergraduate degree programmes

Nola Hewitt-Dundas[a] and Stephen Roper[b]

[a] Enterprise Research Centre and Queen's Management School, Queen's University Belfast, Belfast, BT9 5EE, nm.hewitt@qub.ac.uk

[b] Enterprise Research Centre and Warwick Business School, University of Warwick, Coventry, CV4 7AL, Stephen.roper@wbs.ac.uk

Abstract

In the UK, higher education is increasingly a marketised service sharing many characteristics with other professional services such as legal, medical or financial services. With marketisation comes competition, and the need for Higher Education Institutions (HEIs) to develop and maintain strong programmes to attract and retain high-class faculty and fee-paying students. Here, we consider the drivers of programme innovation – i.e. the introduction of new programmes and the withdrawal of existing programmes - in UK universities. Our focus is on undergraduate programmes as these account for three-quarters of all student enrolments. Using panel data for UK universities we identify significant resource, internationalisation and business engagement effects. Financial stringency and more extensive international market engagement both encourage programme introduction. Collaboration with businesses has offsetting effects depending on the nature of the interaction. The results have both strategic and systemic implications.

Acknowledgements

We are grateful to the University and College Application Service (UCAS) for making available the programme level data on which this analysis is based and the Higher Education Funding Council for England (HEFCE) for providing access to consolidated information on business engagement from the Higher Education Business and Community Interaction survey. Useful comments on an earlier draft of this paper were received from participants in the DRUID Conference 2016 and the UICC Conference 2016. Valuable comments were also received from the Editor and three anonymous reviewers.

Keywords: Higher education; Under-graduate: Innovation; Globalisation; Business engagement

JEL Codes: O39, I23, I25

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1. Introduction

Internationally, higher education 'is moving from being a public good, funded through governments, to a private good where more of the cost is put on students and families' (Kandiko and Blackmore 2010, p. 29). This trend – strongly evident in the UK - positions undergraduate higher education as a 'marketable service' sharing many characteristics with other professional services such as legal, medical or financial services - i.e. their intangible nature, inseparability, and extensive inter-activity between client and provider (Miozzo and Soete 2001). With marketisation comes competition, and the need for Higher Education Institutions (HEIs) to develop and maintain strong portfolios of undergraduate programmes which can attract and retain high-class faculty and fee-paying students. This requires programme innovation – the development and introduction of new programmes and the withdrawal of programmes which are out-dated, unattractive or unviable. To date, studies of programme innovation in higher education have been case-based, focussing on the formulation of organisational strategy in HEIs and the delivery of programme change (Brennan et al. 2014; Kandiko and Blackmore 2010)[1]. Here, we provide an alternative, quantitative, perspective identifying the drivers of undergraduate degree programme introduction and withdrawal across the UK university sector.

Our starting point is a recognition of the complex stakeholder pressures and organisational objectives of universities, and the inherently interactive and social nature of the innovation process (de Medeiros, Ribeiro, and Cortimiglia 2014; Harrison and Leitch 2010). As Jarzabkowski (2005) outlines, 'curriculum change is often a contentious and political

[1] As Perkmann et al. (2013, p. 431) suggest the result has been that 'extant analyses have neglected to consider [innovations'] impact on educational output, such as time devoted to teaching, curriculum and programmes development, and teaching quality'.

endeavour' (p. 26) as a result of a complex stakeholder landscape and a frequent lack of agreement about objectives between academic and administrative staff (McInnis 1998). Here, to reflect the increasing marketisation of undergraduate higher education provision in the UK, we focus on three main drivers of undergraduate programme introduction and withdrawal: the financial performance of each HEI, engagement with international markets and the extent of business engagement.

The context for our analysis is that the UK, like many other countries, has struggled to ensure adequate financing of higher education. Closest to the UK model is that of Australia where student fees (from 1989) and loans (from 2005) have sought to promote diversity and student choice in higher education. Over the same period, the USA has seen a growth of private (non-profit and for-profit) education providers. Models differ, but generic issues remain such as widening access to socially disadvantaged individuals, ensuring the quality of programmes delivered, managing the costs and revenue (fees) models, and ensuring the provision of business-relevant skills (HEPI, 2017). Fundamentally, as HEPI (2017) argue 'reforms under [these] different jurisdictions over the past two or three decades have aimed to open the public higher education system to competition, privatisation and marketisation' (p. 40).

In contrast to the marketised model of higher education in the UK, Australia and the USA, in many European countries universities continue to be funded from tax revenues with no, or limited, student fees. In Germany, modest tuition fees (up to €500 per semester) were introduced by seven Lander from 2006/07. However, in the absence of public support, most of these were abolished within a year with Lower Saxony the last to remove student fees in

2014/15[2]. Despite the desire to publicly fund higher education, the limitations of current funding are apparent with Hillman (2015, 25) quoting the OECD Director for Education and Skills that 'European countries like France, Germany or Spain, too, say higher education is important, but their governments are neither willing to put in the required funds nor allowing universities to charge for tuition'. In Germany, the University Rectors believe that in the absence of tuition fees to supplement public funding, the current system is unsustainable (Hillman, 2015, p. 41).

The higher education system across the world is therefore is changing significantly, not only in response to constrained public finances, but also in response to the international mobility of students, greater sophistication of information and communication technologies and disruptions in technologies and markets that emphasise the importance of lifelong learning. The UK therefore represents a competitive context where increased privatisation (non-profit and increasingly, for-profit) is culminating in the marketisation of higher education. In a complex market with low elasticity of demand to student fees, and further, limited evidence of elasticity of demand to quality improvements as evidenced by improvements in student evaluations, our conceptual and analytical framework here, focuses on University's innovation through programme development.

Our analysis is based on data provided by the Universities and Colleges Admissions Service (UCAS), and draws on concepts from the study of innovation in commercial organisations. We make three main contributions. First, we develop a range of new quantitative indicators of programme introduction and withdrawal in HEIs and use these metrics to profile the main

[2] There are a small number of private higher education providers in Germany and while these universities charge fees, the rate is low and they account for less than 5 per cent of all students (Hillman, 2015)

trends in UK HEIs' programme innovation and withdrawal over the last decade. Second, we use panel data econometric techniques to examine the impact of financial performance, international engagement and business engagement on programme introduction and withdrawal across the UK higher education sector. Each turns out to play a significant role in shaping some aspects of HEIs' undergraduate programme portfolios.

The remainder of the paper is organised as follows. Section 2 provides a brief overview of the context for our study and the increasing marketisation of UK higher education. Section 3 outlines our conceptual framework and hypotheses. Section 4 describes our data which covers the period 2005 to 2013 and draws on information provided by UCAS and the Higher Education Statistics Agency (HESA). Sections 5 and 6 report our empirical analysis and Section 7 considers some of the strategic and systemic implications of the findings. Our focus here is solely on undergraduate programmes which accounted for three-quarters of all registered students in UK Universities in 2013-14. Undergraduate registrations also increased over the study period by 24 per cent in contrast to a smaller 8.4 per cent increase in postgraduate taught programmes (Universities UK, 2015).

2 Policy Context

The full marketisation of higher education would require little or no regulation of market entry by higher education providers, no regulatory limits on fees or numbers of students enrolled, that the cost of teaching was met through fees (as opposed to a combination of fees and grants), and that users would decide what, where and how to study on the basis of information about the price, quality and availability of relevant programmes and providers (Brown 2014). While in many countries e.g. UK, Australia, New Zealand and parts of Canada, there has been a move

towards such marketisation, this has been partial, displaying some of these dimensions. In the UK the shift towards the marketisation of higher education has been significant including an 80 per cent reduction in direct public funding of university teaching, increased price competition, and the introduction of regulatory changes permitting market entry of new providers of undergraduate degrees. These changes have been justified on the basis of growing national current account deficits and a philosophical shift from state to individual-responsibility. This has led to a shift from teaching grants to repayable student loans, ensuring a revenue stream for universities to provide undergraduate education coupled with greater emphasis on the student experience. Changes have been made despite a lack of empirical evidence of any positive effect of a marketized model on student learning outcomes (Taylor and Judson, 2011).

The increased marketisation of higher education in the UK has to be seen in its political context. In the mid-1990s, with a Conservative government in power and spending on education at an historic low, a review of higher education funding was undertaken, chaired by Lord Dearing, 'Higher Education in a Learning Society' (HMSO 1997). One of the central tenets of Conservative policy was to shift the burden of higher education funding from taxation to students. The Labour government (in power from 1997 until 2010) adopted the recommendations of the Dearing review and student fees were introduced in 1998 representing approximately 25 per cent of tutition cost. Fees were contingent on family income[3] and paid back at a later date by the graduate through an income-contingent mechanism (Lupton and Obolenskaya, 2013). This policy was resisted by both students and also Universities who claimed that the funding model was inadequate.

[3] Approximately 40 per cent of students from families in the lowest income band did not pay fees, students in the next income band paid £500 and the remainder paid £1000 per annum (Lupton and Obolenskaya, 2013).

The Labour government's aspiration to reform higher education is evident in the UK White Paper 'The Future of Higher Education' (2003, 22 January), and subsequent Higher Education Act (1 July 2004), which presented plans for radical reform and investment in the higher education sector. The Act consolidated both the recommendations of the earlier 1997 Dearing Report and the Prime Minister's Initiative of 1999[4] which stressed that the UK higher education sector needed to expand to meet rising skill needs, and be more closely aligned with the needs of business and the economy[5]. A participation target in higher education of 50 per cent of 18-30 year olds was implemented and changes made to student fees. From 1998[6], a maximum fee remission grant had existed, however, the 2004 Higher Education Act enabled HEIs to determine their own tuition fees up to a cap of £3000 pa.

In 2010, following the economic crisis a Conservative-Liberal Democrat coalition government came to power. Policy again, as in the pre-Labour government era (1997-2010), emphasised public sector spending cuts to higher education and a move away from a government block-grant to universities towards greater dependence on student fees. Further, until 2013, universities were capped in the number of UK undergraduate students they were permitted to recruit as these students were provided with a fee-loan from government[7]. In effect this led to a 44 per cent real terms fall in spending by the higher education non-departmental public bodies between 2009-10 and 2013-14 (Lupton et al. 2015). Government approved student fees

[4] The 1999 Prime Minister's Initiative (PMI) funded projects targeted at increasing enrolments in both HE and FE. Other countries were undertaking similar investments (e.g. Nuffic Netherlands, AEI Australia, Education New Zealand, Campus France, DAAD Germany, Education USA).
[5] At the same time, there was recognition of significant underinvestment in teaching and research compared to international comparators and that participation in higher education needed to expand.
[6] Teaching and Higher Education Act 1998
[7] From 2012-13 HE Reforms introduced a core and margin system where 85,000 student places were permitted across higher education providers coupled with uncapped recruitment of highly qualified entrants with flexibility for providers offering high quality courses with an average tuition fee of below £7,500 per annum. http://www.publications.parliament.uk/pa/ld201213/ldselect/ldsctech/37/37.pdf

increased to between £6000 pa (minimum) and £9000 pa (maximum), with the maximum value quickly becoming the norm (HEPI, 2014). In addition, this period also saw a substantial increase in alternative (predominantly private) providers of higher education in the UK[8], with student registrations rising from 7,000 in 2010-11 to around 53,000 by 2013-14.

More recently, the UK Government published a further Green paper (BIS, 2015b): 'Fulfilling our potential: Teaching excellence, social mobility and student choice', followed by a White Paper (BIS, 2016): 'Success as a Knowledge Economy', and subsequently by the Higher Education and Research Bill (HMSO, 2017). In the White Paper, government expressed considerable dissatisfaction with the HE sector, including limited access for socially disadvantaged individuals, inflexible courses, a lack of innovation and skill shortages (Fielden and Middlehurst, 2017). To address these deficiencies, an assessment framework to evaluate teaching quality was proposed, later known as the Teaching Excellence Framework (TEF). University's performance on the TEF (assessed at an institutional rather than a subject level) would be associated with differentiated student fees, where the best performing universities would be permitted to increase their fees in-line with government guidelines. Following the passing of the Higher Education and Research Bill (2017) through an Act of Parliament (24th April 2017), and a General Election in June 2017, the proposed differentiation of student undergraduate (Home) fees was postponed.

[8] An alternative provider (AP) is defined as any provider of higher education courses which does not directly receive annual funding from the principal non-departmental government body for higher education (the Higher Education Funding Council for England (HEFCE)) or its equivalent bodies in the devolved administrations, does not receive direct annual public funding and is not a further education college. Student support is however paid to these students and this increased from £50m to £675m between 2010-11 and 2013-14 (Lupton et al. 2015).

An increasingly important additional source of income for UK HEIs has been international student recruitment on which there has been no cap either in terms of the numbers of students recruited or the fees charged. This is particularly poignant given evidence that the elasticity of demand from international students at undergraduate level in response to increased fees is relatively modest. For example, a 1 per cent increase in UG course fees is found to result in a 0.55% reduction in international student enrollments over the following two years (HEPI, 2017). Coinciding with rapid growth in the demand from international (non-EU) students this meant that by 2015-16 the UK had 310,575 non-EU students, accounting for 13.6 per cent of the UK student population.

Over the same period, UK HEIs as have been challenged to liaise more closely with business and other stakeholders in the design and delivery of courses. This mirrored broader (and earlier) efforts to strengthen university engagement on research. In 2003, a review of business-university collaboration (the Lambert Review) concluded that UK government funding for knowledge transfer activities had been important in changing the culture among universities towards greater collaboration with business. Yet, significant potential existed to further increase the scale of this activity, with the UK Government's Science and Innovation Investment Framework 2004-2014 (July 2004) commenting that: 'Over the next ten years, it is critical that the levels of business engagement with the science base increase, to realise fully the economic potential of the outputs of our scientists and engineers to turn basic and strategic research into successful new products and services, and to engage more fully with business'. In 2015, the Dowling Review of business-university research collaborations reported substantial increases in business-university engagement yet called for further integration of university and business in the Government's industrial strategy in pursuit of growth and productivity (BIS, 2015a).

With the shift towards the marketisation of higher education in the UK, a competitive higher education landscape has emerged. Education providers seek to attract students as an important source of revenue, with quality assessed by potential students through student surveys and metrics on issues such as staff-student ratios and employability rates. Scott (see HEPI, 2009) argues that potential students do source information on higher education providers, but this relates more to 'reputation' than 'quality': 'The growing number of guides (to reputation, I would argue, not quality) is certainly evidence of an increasingly 'consumerist' mentality… but they merely codify… well-established pecking/prejudice orders' (HEPI, 2009)[9].

Reputation and the associated legitimacy of higher education providers, has been instrumental in universities forming 'Mission Groups'. These Groups 'are a product of the desire of different self-identified groups of universities to express policy positions that they believe will enhance the welfare of their own members (although invariably making their case regarding the general welfare of the higher education system) and to lobby to achieve their implementation' (Filippakou and Tapper 2015, p. 123). One of the first self-identified Groups was the 'Russell Group' formed in 1994 (www.russellgroup.ac.uk), a consortium of (now) 24 research intensive universities including Oxford, Cambridge, Imperial, Queen's Belfast and most recently Durham and York. By 2004/05 Russell Group Universities accounted for 65% (over £1.8 billion) of UK Universities' research grant and contract income, 56% of all doctorates awarded in the United Kingdom, and over 30% of all students studying in the United Kingdom from outside the EU. Various other self-identified groups have emerged over the past 20 years, however: the University Alliance (www.unialliance.ac.uk/member) is a group of 20 UK

[9] http://www.hepi.ac.uk/2009/03/18/the-role-of-the-market-in-higher-education/ no page numbers available.

universities most of which were established in the post-1992 period, and including universities such as Manchester Met, Coventry, Greenwich and Huddersfield; the Million+ group (www.millionplus.ac.uk), formerly the Campaign for Mainstream Universities (CMU), represents 17 universities established since 1992 including London South Bank, the University of the West of England and Abertay University.

3. Conceptual Framework and Hypotheses

Definitions of innovation vary but generally, in the context of 'for profit' enterprises, they stress the commercialisation of new knowledge or technology to generate increased sales or value for consumers or related stakeholders. The US Advisory Committee on Measuring Innovation, for example, defines innovation as: 'The design, invention, development and/or implementation of new or altered products, services, processes, systems, organisational structures or business models for the purpose of creating new value for customers and financial returns for the firm' (Advisory Committee on Measuring Innovation in the 21st Century Economy 2008, p. i). Our focus here is on the introduction of new programmes at an undergraduate level which may be attractive – offer value – to students, and which may generate financial returns or strategic or reputational benefits for universities (Schatzel, Calantone, and Droge 2001). We are also concerned here with the withdrawal or cancellation of programmes, a subject which has received considerably less attention in the management literature outside pharmaceuticals (Bunniran et al. 2009).

Both programme introduction and withdrawal are inherantly social and interactive processes, in which outcomes are dependent on the pressures on the actors involved in the process, the capabilities of those contributing, and their level and openness of interaction (de Medeiros, Ribeiro, and Cortimiglia 2014; Harrison and Leitch 2010). As a result, little commonality emerges in innovation processes between HEIs with heads of department in leading universities

adopting varied top-down and bottom-up mechanisms to manage change. Systemic perspectives provide a useful analytical framework within which to examine innovation in both the commercial (de Zubielqui et al. 2015; Kauffeld-Monz and Fritsch 2013; Trippl 2011) and higher education contexts (Brennan et al. 2014). Brennan et al. (2014, p. 37), for example, define the higher education innovation system as the 'sub-set of an [economy wide] innovation system concentrated particularly in higher education institutions (universities and associated research institutes, vocational training institutions, master's colleges, etc.), which are in close connection with other institutional spheres, such as industry, government and non-government agencies, and the society at large'. Beyond the constituent actors and institutional characteristics, innovation systems also comprise 'functions' which, in the case of higher education, Brennan et al. (2014) suggest can be identified as education, research and third-mission activities. Programme introduction and withdrawal are central to the education function of the higher education innovation system, and may be driven either by endogenous processes, factors outside the immediate innovation system, or a complex combination of both (Kandiko and Blackmore 2010).

At a systemic level, drivers of innovation in higher education may include economic crises, as witnessed during the 2008 global economic recession, budget increases or cuts to the funding of higher education etc. In recent years, many countries have replaced trust-based funding regimes, where universities automatically received a grant allocation from government with little account of their output and outcomes, to performance-based or competitive funding mechanisms (Geuna and Martin, 2001; Conraths and Smidt, 2005; Orr et al 2007; Sorlin, 2007), the rationale being that this leads to more efficient allocation of public resources and creates diversity in the university sector (Sorlin, 2007).

In the UK, while public funding of teaching through the shift from taxation to student fees has largely been applied uniformly across the sector, funding for research and knowledge transfer activities have been on a competitive basis (Hewitt-Dundas, 2012). This competitive funding has led to 'diversity of excellence' (HM Treasury 2007) in the research base between 'research universities focusing on curiosity-driven research, teaching and knowledge transfer, and business-facing universities focusing on the equally important economic mission of professional teaching, user-driven research and problem-solving with local and regional companies' (HM Treasury 2007, p.5). In other words, research quality has been a key differentiating feature of heterogeneity in knowledge transfer strategies and activities in the university sector. While this policy approach has been detached from funding for teaching, some argue that government pressure to increase the economic benefit of universities has been evidenced in proposals to reduce support for arts-based degree programmes (Kandiko and Blackmore 2010).

Aligned to changes in government funding priorities, at an organisational level, factors such as the autonomy of a university can be a key determinant of innovative activity (Brennan et al. 2014). Financial stringency may be used by senior managers in universities as a pretext for driving programme change: 'Finance and marketing often provide the motivation for change but may be part of an agenda that is not made explicit, and is sometimes perceived to be hidden' (Kandiko and Blackmore 2010, p. 28). We therefore suggest that (Figure 1):

> Hypothesis 1a: Stronger HEI financial performance will be associated with *reduced* levels of programme introduction;
>
> Hypothesis 1b: Stronger HEI financial performance will be associated with *reduced* levels of programme withdrawal.

Sorlin (2007) argues that performance-based funding acts as an important policy instrument in the allocation of resources to universities. Specifically, using metrics to measure deliverables and outputs, it allows governments to invest more efficiently in R&D while also creating diversity in the university sector. In the UK, a meritocratic funding system for higher education, tends to reward successful research universities creating differentiation in the university sector as the 'existing research elite is further reinforced and the status quo is maintained' (Guena and Martin 2001, 28) through vertical differentiation with the potential for functional specialisation (Sorlin 2007). This implies that where teaching accounts for a higher proportion of total university income it is likely to have a greater impact on programme introduction and withdrawal. This leads to our second hypothesis:

> Hypothesis 2: The more important teaching income is in the revenue mix of a university the stronger will be its effect on levels of programme introduction and withdrawal.

Brennan et al. (2014) argue too that one of the key external drivers of higher education innovation has been pressure from the globalisation of competition for students and faculty[10]. For example, following McMahon et al. (1992) analyses of the study choices of international students have emphasised quality and reputational factors as the primary drivers of institutional choice. Gatfield and Chen (2006), for example, analysed the preferences of 518 Taiwanese students and suggested that UK universities should 'continue to emphasise and promote the high quality and reputation of [their] educational services' (2006, p. 90)[11]. Similarly, Maringe and Carter (2007, p. 460) investigated the preferences of African students studying in the UK and argued that 'a good understanding of students' decision-making processes creates a sound

[10] In terms of programme innovation specifically we might also add the potential impact of initiatives such as the European Bologna Process although the impact of this remains 'patchy' across UK universities. See, for example, 'UK must wake up to Bologna benefits', Times Higher Education Supplement, April 6, 2007.

[11] Some other issues are perhaps more difficult to overcome, viz 'according to the results from in-depth interviews, some Taiwanese people have the stereotype of the UK that it has a cloudy, snowy and cold winter, not an exciting place to live and with some personal safety problems' (Gatfield and Chen, 2006, p. 90).

basis for developing curriculum programmes that address the real rather than the perceived needs of this group of scholars'. They explored the preferences of 28 African students studying in England, and while the quality of UK higher education qualifications was the primary 'pull' factor at the country level, the primary institutional pull factor was programme availability (Mariange and Carter, 2007, Figure 1, p. 471). Based on a sample of 160 predominantly post-graduate students in the UK Wilkins et al. (2011) also found that the factors most often identified as being 'very important' in determining their decision to study in the UK were quality of education, high international league table rankings, employment prospects and opportunities to improve English language skills. Students' choice of institution then depended most strongly on the reputation of a university, the quality of programmes, rankings, programme content, and the reputation of faculty.

In terms of the domestic environment for higher education, the removal of the cap on domestic undergraduate student numbers announced in the UK Autumn Statement in 2013 removed one major constraint on competition, a trend which may be exacerbated if – as some have anticipated – the cap on tuition fees is removed in future[12]. Interestingly, however, recent studies have suggested that home students' institutional choices are only weakly linked to the level of tuition fees (Burge et al. 2014), or as one study put it, there is little evidence that 'student mobility is driven by economic rationality' (Wakeling and Jefferies 2013, p. 510). Instead, what seems to dominate students' choices are quality – as reflected in student satisfaction surveys - and employability. In Australia, Maazzarol et al. (2001), for example, surveyed 828 domestic students and found that future employment prospects were the primary

[12] Scott, P (2014) 'End to cap on university student numbers clears path for private equity', The Guardian, 4th March 2014. Available at: http://www.theguardian.com/education/2014/mar/04/george-osborne-fee-cap-policy-private-equity. Accessed 21st May 2015.

factor governing institutional choice followed by a range of factors linked to 'resources and programmes'.

This suggests that the incentives for effective programme innovation are strong, particularly where 'national systems have become heavily dependent on the recruitment of overseas students paying high fees in order to sustain their internationally-focussed layer of universities' (Kandiko and Blackmore 2010, p. 26). We therefore suggest that (Figure 1):

> Hypothesis 3a: Greater engagement with international markets will be associated with *increased* levels of programme introduction;
>
> Hypothesis 3b: Greater engagement with international markets will be associated with *increased* levels of programme withdrawal.

Alongside the marketisation of UK universities' teaching activities in recent years there has also been a considerable development of third-mission activity related primarily to business engagement (Muscio, Quaglione, and Vallanti 2015). These linkages create the potential for knowledge co-creation and the more effective tailoring of university programmes to meet industry needs. Hence: as Kandiko and Blackmore (2010, p. 27) found: 'In general, we found institutions that made successful changes worked with external agencies to gather opinions about curricula and graduate attributes, feeding the ideas into the processes of change'. More recently Plewa et al. (2015) investigated the role of five different forms of university-business interaction on the design and delivery of university programmes across a range of countries and concluded that 'the instruments examined in this study emerge as encouraging business to collaborate with HEIs in the context of curriculum design and development, aimed at co-

creating value with the business community' (Plewa et al. 2015, p. 46). Further evidence on this relationship is limited, however, based on these findings we suggest that (Figure 1):

Hypothesis 4a: Greater engagement with business will be associated with *increased* levels of programme introduction;

Hypothesis 4b: Greater engagement with business will be associated with *increased* levels of programme withdrawal.

4. Data and methods

Our empirical analysis relates to the 2005 to 2013 period and is based on data compiled from four main sources: programme data for each individual degree programme was provided by UCAS; data on business interaction by each HEI is taken from the Higher Education Business and Community Interaction (HE-BCI) survey; data on institutions' financial performance and market positioning was derived from the Higher Education Statistics Agency (HESA) HEIDI database; and data on research performance is taken from HSEA research performance data. Each is described in turn.

Programme data: This was provided on a year-by-year basis for all individual programmes offered through the UCAS system from 2005 to 2013. For each programme, we were provided with a unique identifier, programme title, the number of places accepted and the breakdown of places accepted by UK, EU and non-EU applicants[13]. This data was collated into a time series

[13] UCAS provides access to undergraduate programmes provided by both Higher Education and some Further Education providers. The Higher Education Statistics Agency identifies 164 Higher Education Providers in the UK (Source: https://www.hesa.ac.uk/component/heicontacts. Accessed: 10 April 2015) of which fifteen do not accept applications through UCAS either because they are specialist institutions and handle their own admissions (e.g. the Royal Northern College of Music, Open University) or because they are postgraduate only institutions (e.g. Cranfield, London Business School). Our analysis therefore covers 149 or 90.8 per cent of higher education providers in the UK, i.e. those engaged in the provision of undergraduate programmes and who accept applications through UCAS. In terms of the programmes on offer through UCAS this group of HE providers accounted for 90.1 per cent of all programmes on offer in 2013 (2006, 94.1 per cent) with the remainder being offered primarily by further education providers.

for each programme, providing an indication of whether programmes were in place for the whole of the 2005 to 2013 period or whether they were newly introduced or withdrawn in each year during this period[14]. Programme introduction occurs at the point students are first recruited to a new programme by an HEI[15]. Programme withdrawal is when a programme is dropped from the range of programmes provided by an individual HEI and no students are recruited. To illustrate, Annex 1 provides a list of undergraduate programmes introduced and withdrawn by the University of Warwick over the sample period. For the empirical analysis, we define three different measures of programme withdrawal and introduction which reflect the binary introduction/withdrawal decision as well as the impact of those decisions on the number of student places on offer[16]. Figure 2 provides an overview of derivation of the three measures for the introduction and withdrawal of a single degree programme. Measure ST1 is a simple binary indicator of introduction and withdrawal. Measure ST2 is a measure of the importance of each course which takes the value of the number of students on the programme in the last (or first) year in which students were recruited. Measure ST3 takes the average value of the number of students recruited in the last two (or first two) years of a programme, and is intended to reflect the longer-term impact of programme changes. Individual time series (ST1, ST2 and ST3 for programme introduction and withdrawal) for each programme were then aggregated to provide time series for each HEI. At the level of the institution, ST1 provides an indication of the number of programmes introduced or withdrawn each year. ST2 and ST3 provide an indication of the number of students involved in these programme changes and, as institutional incomes relate directly to student recruitment, an indication of the importance of the changes in terms

[14] In a limited number of cases programmes accepted no applicants in year t but did have acceptances in years t-1 and t+1. In this situation, the programme was said to be 'in place' throughout the t-1 to t+1 period.
[15] A programme may be new-to-the-institution, having previously been provided elsewhere, or new-to-the-market, the first time a programme is introduced across the HEI sector.
[16] Marketisation means that university revenues from teaching are directly linked to student numbers. Measures ST2 and ST3 therefore provide an indication of the revenue implications for HEIs of programme introduction and withdrawal.

of revenue. To normalise the measures for institution size we focus here on introduction and withdrawal rates for each measure. If $ST1_{it}$ is the number of programme introductions made by institution i in period t, and $ST2_{it}$ and $ST3_{it}$ the number of student places involved, P_{it} is the total number of programmes on offer by institution i and SN_{it} the total number of student places, then the introduction rates are defined as:

$$\textbf{\textit{Introduction rate }}\boldsymbol{ST1_{it}} = \frac{\boldsymbol{ST1_{it}x\ 100}}{\boldsymbol{P_{it-1}}}$$

$$\textbf{\textit{Introduction rate }}\boldsymbol{ST2_{it}} = \frac{\boldsymbol{ST2_{it}x\ 100}}{\boldsymbol{SN_{it-1}}}$$

$$\textbf{\textit{Introduction rate }}\boldsymbol{ST3_{it}} = \frac{\boldsymbol{ST1_{it}x\ 100}}{\boldsymbol{SN_{it-1}}}$$

Withdrawal rates are similarly defined for each of the three measures. On average over the 2007 to 2013 period HEIs' average introduction rate (ST1) averaged 13.4 per cent while the proportion of students involved were 7.4-8.6 per cent (Table 1)[17]. Withdrawal rates were marginally higher at 15.2 per cent in terms of the number of programmes although student numbers were lower at 5.9-8.0 per cent (Table 1). The comparisons suggest both that newly introduced programmes and those withdrawn involved smaller than average numbers of students, and that withdrawn courses – on average – involved fewer students than new programmes.

Within HEIs' portfolios of undergraduate programmes we make two other distinctions. First, we distinguish between the introduction and withdrawal of STEM and non-STEM programmes. Here, we use the JACs 3 programme coding to allocate programmes to either the STEM or non-STEM categories[18]. On average around 35.5 per cent of programmes were in

[17] Annex 2 provides the correlation matrix for the variables used in the empirical analysis.
[18] Where degrees are joint or major/minor we base the allocation on the first named subject. So, biology and French would be STEM while French and Biology would be categorised as non-STEM.

STEM subjects (Table 1). Second, we distinguish between single subject programmes, those involving joint subjects and those which offer a major-minor combination. Single subject programmes include traditional disciplinary degrees (e.g. Zoology, Veterinary Science) but also more contemporary additions such as Visual Communications, Web Technologies and Viking Studies[19]. We classify programmes as 'joint subject' programmes when two subjects are named, where each one might be a single subject programme in its own right, and where no prioritisation is implied in the programme name. Examples would be: Sport and Physical Education, Business and Management, Theology and Religious Studies. Finally, major-minor programmes would be those where again each element of the degree might be a single programme in its own right but where there is clearly a primary discipline. Examples here would be: Zoology with Animal Ecology, Theatre Studies with English Literature or Politics with History. Over the 2007 to 2013 period single subject courses accounted for around 53.2 per cent of all undergraduate programmes on offer, 12.1 per cent were major/minor combinations and the remainder joint programmes (Table 1).

Financial performance data: To reflect the financial viability of the HEI and the importance of teaching income as a source of revenue we extracted three indicators from the Key Financial Indicators section of the Higher Education Information Database for Institutions (HEIDI) database run by the Higher Education Statistics Agency. These are: the percentage ratio of tuition fees & education contracts to total income (%); the percentage ratio of historical surplus/(deficit) for the year after taxation to total income (%); and the ratio of current assets to liabilities.

[19] One limitation of this approach – and one which it is hard to overcome with our data – is the extent to which new programmes are inter-disciplinary focussing on specific topic areas. European Studies, for example, is generally an inherently inter-disciplinary degree programme but would be categorised in our data as a single-subject programme.

External market engagement: We measure each HEIs' engagement with international markets using the percentage of non-EU students accepting places in each year. This is derived from the UCAS database.

Business engagement: This is measured using two indicators derived from the Higher Education – Business and Community Interaction Survey (HE-BCI) database which is the main source of information on knowledge exchange activities in UK universities. Collected by the UK Higher Education Statistics Agency (HESA) this is an annual and mandatory survey of all UK Universities and therefore provides a comprehensive profile of engagement activities[20]. The survey provides information on specific interactions with external partners, such as contract and collaborative research, consultancy, continuing professional development and intellectual property. We derive two measures from the HE-BCI survey designed to reflect the breadth of university-business interaction. In each case measures from the HE-BCI survey are normalised by the number of academic staff in the institution. The two measures are: income from research contracts with business per academic staff employee, and income from facilities and equipment contracts per academic staff employee.

Control variables: Four groups of time-variant control variables are included in the estimation. First, we reflect the research performance of each institution using the HESA research output performance metric for the value of research grants obtained[21]. Published until 2015, this metric provides an annual indication of research grant income by institution normalised by departmental composition and institution size[22]. To allow for the potential difference in the

[20] https://www.hesa.ac.uk/index.php?option=com_studrec&Itemid=232&mnl=14032
[21] See for example: https://www.hesa.ac.uk/files/Performance%20Indicators%202012-13%20-%20Research%20output.zip. Accessed: 20 July 2017.
[22] For details see https://www.hesa.ac.uk/data-and-analysis/performance-indicators/research/technical.

relationship between research grant income and programme introduction and withdrawal between research-intensive and less research-intensive institutions, we include four control variables in the analysis representing research grant income by Mission Group. Second, it is often argued that organisations with more diverse staff composition may be more likely to innovate (Konnola, Brummer, and Salo 2007; Ostergaard, Timmermans, and Kristinsson 2011; Winkler and Bouncken 2011). We therefore include two indicators to represent the diversity of university staff based on categorical breakdowns of staff by ethnicity and gender derived from the HEIDI database. In each case, we construct Blau indices where p is the proportion of staff in a category and N is the number of categories (Blau 1977):

$$B = 1 - \sum_{i=1}^{N} p_i^2$$

Higher values of the Blau indices occur when staff are divided equally between gender or ethnic groups suggesting greater diversity. Third, we include three measures intended to control for the resource base of the HEI: an indicator of the overall size of the HEI (log employment), a measure which is standardly used in studies of innovation as a proxy for corporate resources (Jordan and O'Leary 2007); and two indicators of the (log) number of academic staff and number of students per programme[23]. Fourth, recognising that levels of programme introduction and withdrawal may also vary between different subject groups we also include variables representing the share of programmes in STEM subjects, and those which are either single subject or major/minor combinations. Each of these variables was derived from the UCAS programme data.

[23] In each case staff and student numbers were derived from the HEIDI database. The number of programmes per institution is taken from the UCAS data.

Our data forms a balanced panel from 2006 to 2013 and we therefore use panel data estimation approaches. As we anticipate that there might be strong institutional fixed effects, our preferred approach is to estimate panel regressions with fixed effects, an approach confirmed by the relevant Hausman tests. In all models we include a lagged dependent variable and year dummies and all independent variables are all lagged one or more years to eliminate any issues of reverse causality.

5. Empirical analysis

The total number of undergraduate programmes on offer from UK HEIs fell steadily during our study period, peaking at around 17,800 in 2006 and falling below 14,500 in 2013, a fall of around 7.4 per cent (Figure 3)[24]. Around 1:7 programmes are newly introduced or withdrawn each year with the withdrawal rate running ahead of the introduction rate from 2010 to 2012 (Figure 4). The largest number of individual programmes on offer in 2013 was from Manchester Metropolitan University (316) with a number of other universities offering more than two hundred separate programmes (Kingston, 229; Leeds, 229; Edinburgh, 218; Manchester, 218; Central Lancashire, 211 and Kent, 203). The mean number of programmes offered per institution was 98.9 (SD=60.6). The different introduction and withdrawal rates defined earlier follow essentially similar time profiles although, as noted earlier, the level of each rate based on student numbers (ST2 and ST3) are lower than those based on the simple count of newly introduced and withdrawn programmes (Figure 5).

Baseline models of our introduction and withdrawal metrics for the whole UK HEI sector are given in Table 2. In each case, Hausman tests suggest the superiority of models including fixed

[24] We exclude from our analysis some Welsh HEIs which have gone through a merger during our study period. These include Glyndwr University, University of Wales Trinity Saint David and the University of South Wales.

effects for each institution[25]. All models also include a lagged dependent variable and year dummies as well as the range of control variables described earlier. Hypothesis 1 suggests that where an HEI is in a stronger financial position this might reduce the impetus to make programme introductions or withdrawals. We find strong support for hypothesis H1a (introduction rates) for each of the three metrics (Table 2). We see similar negative coefficients in the models for withdrawal rates (H1b), although this is only significant for one of the three programme withdrawal metrics (Table 2, Model 4). Overall, therefore for the sector as a whole, we find a relatively strong link between financial stringency and programme introduction and withdrawal: When UK universities are in a stronger financial position rather than encouraging programme innovation this has a negative effect. Conversely, financial stringency drives both programme innovation and, to some extent, withdrawal.

Hypothesis 2 suggests that innovation and withdrawal rates will be more strongly affected where teaching income is a more important source of revenue for an institution. For the sector as a whole, we find little consistent support for this hypothesis, however, with teaching income as a proportion of total income generally insignificant (Table 2). The implication is that it is the level of financial stringency which matters in terms of its impact on HEIs' programme introduction and withdrawal rather than the institution's revenue profile. This is perhaps somewhat surprising given that the percentage of income derived from teaching varies significantly across UK universities - universities in the elite Russell Group derived 26.2 per cent of their income from teaching compared to an average of 38.0 per cent for all other universities.

[25] Hausman test statistics for Table 2 are as follows: introduction rate ST1, $\chi 2$ (23)=241.55, ρ=0.000; withdrawal rate ST1, $\chi 2$ (23)=219.19, ρ=0.000; introduction rate ST2, $\chi 2$ (23)=187.87, ρ=0.000; withdrawal rate ST2, $\chi 2$ (23)=189.76, ρ=0.000; introduction rate ST3, $\chi 2$ (23)=162.74, ρ=0.000; withdrawal rate ST3, $\chi 2$ (23)=158.14, ρ=0.000.

Reflecting other evidence that internationalisation can be a spur to innovation in higher education (Boso et al. 2013; Chen 2012; Golovko and Valentini 2011; Roper and Love 2002) Hypothesis 3 suggests that internationalisation will have a positive stimulus on introduction and withdrawal rates. We find consistent evidence that internationalisation provides a spur to new programme introduction (Table 2, Models 1 and 3), but no evidence that increasing internationalisation has had any significant influence on programme withdrawal (Table 2). Again, it is important to acknowledge, however, that the average percentage of non-EU students varies widely between different Mission Groups of UK universities (e.g. 13.1 per cent of accepted places in Russell Group universities and 4.8 per cent elsewhere[26]) and that even within Mission Groups there is wide variation in the proportion of non-EU students[27]. We explore the impact of these contrasts below[28].

Our final hypothesis, reflects the increasing importance of third mission activity and university-business engagement, and suggests that the greater university engagement with business the higher will be levels of programme introduction and withdrawal. Here, we find mixed evidence. Contract research has positive but insignificant effects on programme introduction and withdrawal for the sector as a whole (Table 2). This may reflect universities' attempts to match programme offerings to the needs of business, or reflect changes made to programmes on the basis of learning through contract research. Where universities derive revenue from facilities and equipment contracts with businesses, however, this has a strong and unanticipated negative effect on programme introduction and withdrawal (Table 2). Two potential – and non-

[26] These figures are based on the number of places accepted by non-EU students through the UCAS system. They do not include places offered directly from any universities and may therefore under-estimate the share of non-EU students

[27] The coefficient of variation in terms of the share of accepted places by non-EU students for the Russell Group universities is 0.67 while that for other universities is 1.26.

[28] It is also important to acknowledge that our analysis relates only to programme introduction and withdrawal in undergraduate programmes; for many universities internationalisation has perhaps had more impact on pre-experience post-graduate programmes.

exclusive - explanations are possible. First, it may be that these contracts act as a distraction for staff leading to lower levels of engagement with programme introduction and withdrawal. Another, perhaps more plausible, interpretation is that these contracts are a source of additional revenue for departments and may be reducing the financial pressure for programme introduction and withdrawal.

Our control variables suggest some other important influences on programme innovation and withdrawal. Larger universities generally have lower programme introduction and higher withdrawal rates than smaller institutions, perhaps reflecting their better programme development and monitoring capabilities (Table 2). Research grants also have a significant effect on programme introduction and withdrawal rates although this relationship varies between Mission groups (Table 2). Perhaps surprisingly, given its implications for the income of the institution, the average number of students per programme has no significant effect on programme introduction and withdrawal. Variations in the popularity of specific courses or subjects would perhaps be more likely to stimulate introduction or withdrawal in related areas. Unlike the students per programme variable, the number of faculty per programme does prove highly significant: more faculty per programme encourages new programme introduction but discourages programme withdrawal. Ethnic diversity among faculty has a significant negative effect on programme introduction and withdrawal rates, while universities with a higher proportion of major-minor programmes are more likely to have both higher programme introduction and withdrawal rates (Table 2).

6. Robustness sub-sample estimates

Programme introduction and withdrawal in higher education can be a lengthy process, and in Table 3 we explore longer (two-year) lags between our key explanatory variables and

programme introduction and withdrawal rates for the sector as a whole. As in the earlier analysis we find strong negative effects on programme introduction and withdrawal from HEI's receipt of revenue from facilities and equipment contracts with businesses (Table 3). Business research contracts here have stronger effects than in the earlier models, significantly increasing programme withdrawal rates (Table 3). Other effects related to HEIs' financial status and engagement with international students prove more short-term, becoming largely insignificant when included in the models with a two-year lag (Table 3). In the case of HEIs' financial status this may perhaps reflect the timing of actual programme introduction or withdrawal decisions rather than the time taken to develop new or alternative programmes.

Tables 4-6 explore our key hypotheses for the different Mission Groups within the UK HEI sector. In each case, we partition the variables of interest between Mission Groups to explore the consistency of effects across all HEIs. In technical terms, this amounts to relaxing the restriction implicit in Table 2, for example, that financial stringency has the same impact on programme introduction and withdrawal rates for the members of each Mission Group. As it turns out, the financial status of the university has no significant impact on programme introduction and withdrawal for the more research intensive Russell Group universities, but is more influential for the members of each of the other three Mission Groups (Table 4). Engagement with non-EU students, has significant effects on programme rates for each of the Mission Groups with the exception of University Alliance members (Table 5). As in the sector as a whole (Table 2), we find no significant relationship between engagement with non-EU students and programme withdrawal for any of the Mission Groups (Table 5). Finally, while business research contracts have only weak effects for each of the Mission Groups, revenue from Facilities and Equipment contracts proves significant for both Russell Group and Non-Aligned HEIs (Table 6).

7. Conclusions

A key function of universities is the provision of under-graduate education. The increasing marketisation of higher education requires that to remain attractive to potential students and faculty, HEIs have to update and change their portfolio of programmes. Here, we believe for the first time, we adopt a quantitative approach to investigate the drivers of programme introduction and withdrawal in the UK university sector. Our analysis suggests three main empirical results. First, financial stringency stimulates both programme introduction and withdrawal. That is, universities which are facing greater financial pressures are more likely to introduce new programmes and withdraw existing programmes. This effect is relatively short term, perhaps reflecting decision cycles, and is strongest in less research-intensive universities. Second, while business engagement through contract research has little impact on programme introduction and withdrawal rates, revenue from facilities and equipment contracts tends to reduce programme introduction and withdrawal rates. This effect is persistent, and impacts on both research-intensive and less research-intensive institutions. Third, higher levels of internationalisation stimulate programme innovation across both research intensive and less research-intensive institutions although internationalisation has a weaker influence on withdrawal rates.

Over the period covered by our estimation (2007-13) the number of programmes on offer to undergraduates in the UK fell markedly (Figure 3). This is consistent with an increasingly difficult funding climate for higher education and the consequent rationalisation of programmes which has seen higher programme withdrawal than introduction rates (Figure 5). Our analysis suggests that the marketisation of university activity – reflected in greater internationalisation and third-mission activity – has been important in influencing both programme innovation and withdrawal and that the effects of marketisation go beyond the well-

recognised impacts on the content or delivery modes of particular programmes to influence the subject focus of programmes themselves (Brennan et al. 2014). This raises pedagogic issues related to the depth of disciplinary training (Kandiko and Blackmore 2010) as well as reflecting wider debates about the role of universities in society and the wider economy (Mowery et al. 2004).

At a strategic level our study emphasises the complexity of influences which shape university agendas (Jarzabkowski 2005). Changes in under-graduate programmes are influenced by internal resource availability, and the nature and extent of institutions' interactions with other elements of the higher education innovation eco-system and wider economy (Brennan et al. 2014). Our evidence on the impacts of collaborative research and facilities and equipment contracts, in particular, emphasises the importance of adopting a systemic approach to HEI innovation (Muscio, Quaglione, and Vallanti 2015). This focuses attention on the governance arrangements covering university-business interactions and institutions' ability to capture the potential learning from such relationships for subsequent programme development (Geuna and Muscio 2009; Young et al. 2008).

As public financial support for teaching in UK higher education continues to decline, and limits on student fees are relaxed, the drivers of programme innovation may change to become much more student-centred. The UK higher education market is extremely complex and to date demand has proved to be relatively inelastic to both price and quality changes (HEPI, 2016). What appears to have been more important in student choice has been University reputation, a factor which is likely to further entrench existing differences in the sector, such as those which we have examined here between University Mission Groups.

Our study is subject to a number of limitations, some of which suggest interesting avenues for further research. First, our study is limited to the UK and inevitably therefore reflects national policy changes and institutional specificities. International replication has obvious potential. Second, our study is confined to under-graduate programmes. Although these programmes cover around three-quarters of UK HEI students, arguably the area of most innovative activity in the UK higher education sector in recent years has been at the taught post-graduate level. Extending the type of analysis conducted here to look at the influences on programme innovation in specialist masters programmes, would be a valuable next step but, for the UK at least, would be complex operationally due to the lack of any co-ordinated student application system.

Figure 1: Conceptual framework

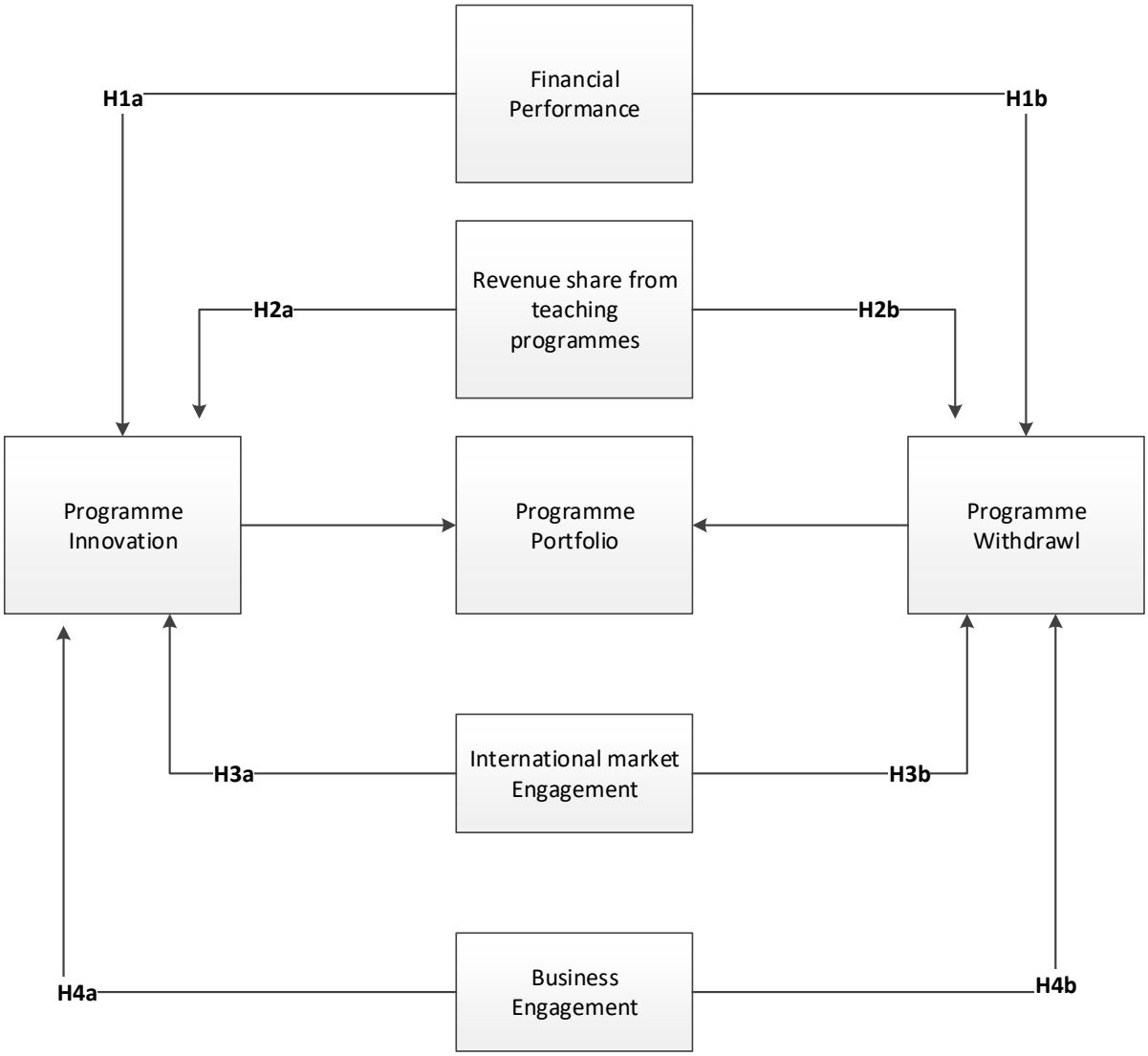
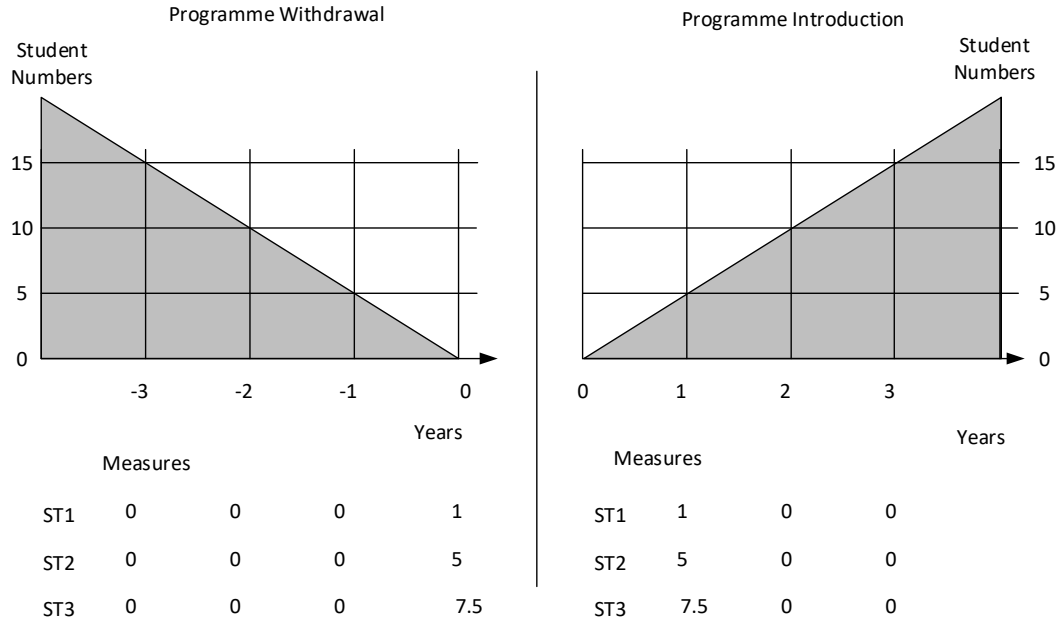


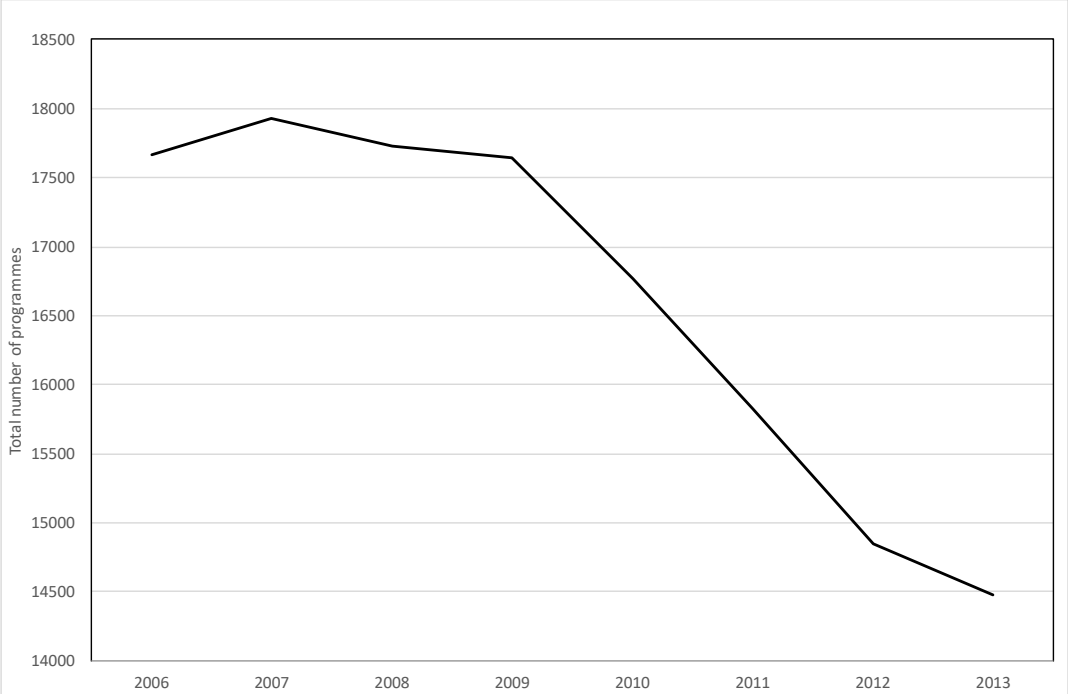
Figure 2: Measures for programme introduction and withdrawal



Measures				
ST1	0	0	0	1
ST2	0	0	0	5
ST3	0	0	0	7.5

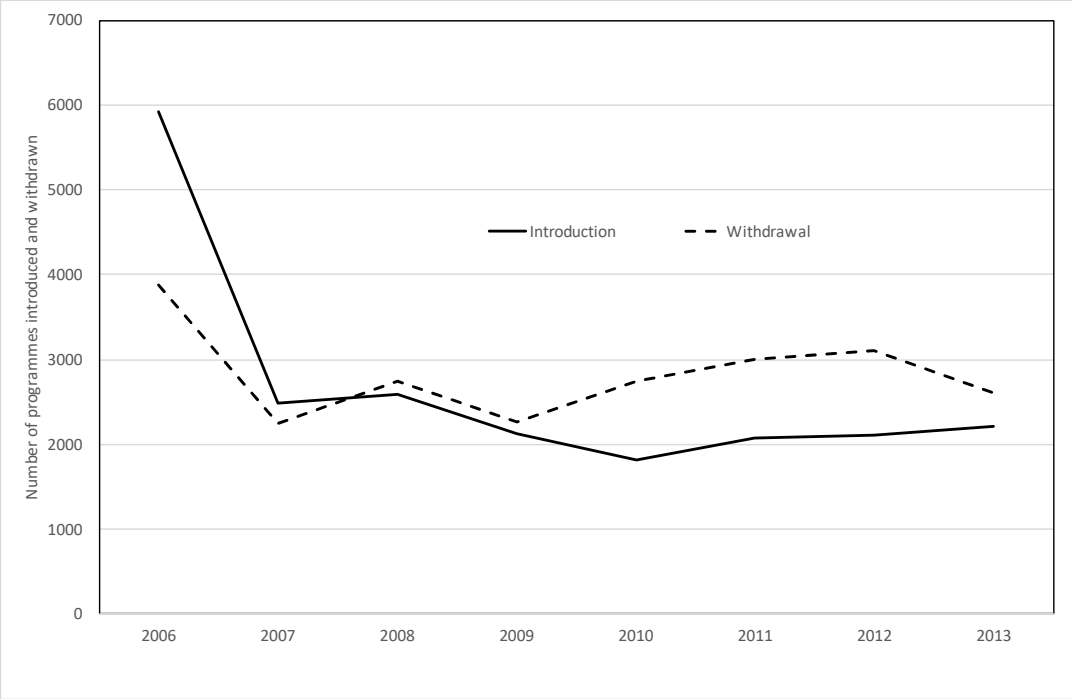
Measures			
ST1	1	0	0
ST2	5	0	0
ST3	7.5	0	0

Figure 3: Total number of programmes offered by UK HEIs



Source: UCAS, Authors' analysis

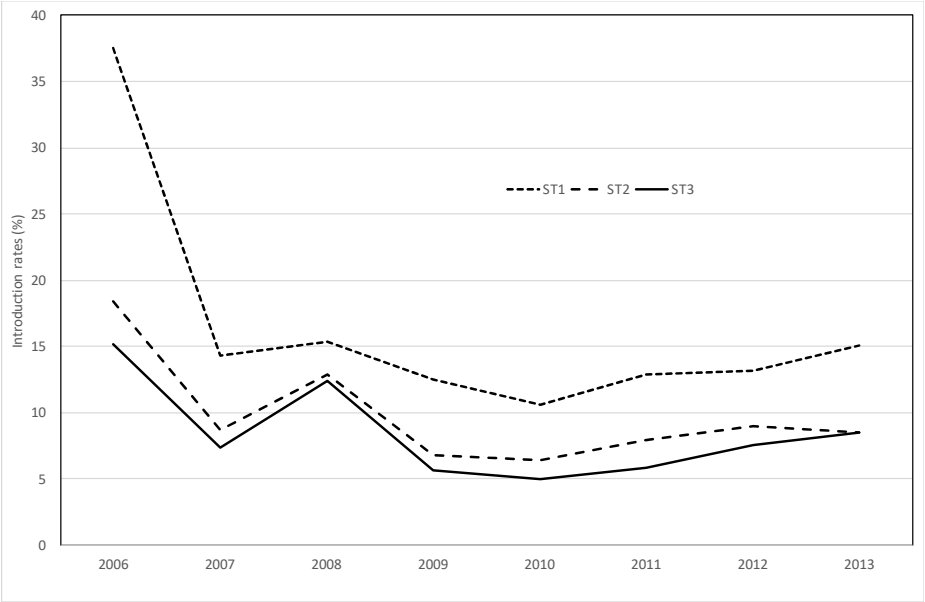
Figure 4: Number of programmes introduced and withdrawn by HEIs



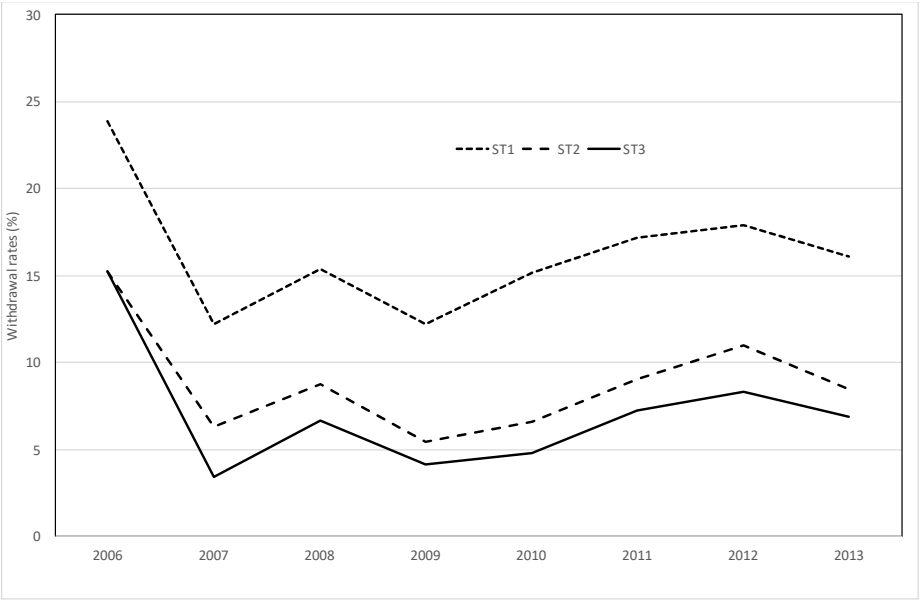
Source: UCAS, Authors' analysis

Figure 5: Introduction and withdrawal rates

(a) Introduction rates



(b) Withdrawal rates



Source: UCAS, Authors' analysis

Table 1: Panel data descriptives

Variable	Number of observations	Mean	Std. Dev
Introduction measures			
ST1 – per cent of programmes (%)	1,000	13.427	10.682
ST2 – per cent of students (%)	855	8.584	7.895
ST3 – per cent of students (%)	855	7.446	7.631
Withdrawal measures			
ST1 - Withdrawal rate (%)	1,000	15.175	9.745
ST2 – per cent of students (%)	855	7.958	7.806
ST3 – per cent of students (%)	855	5.946	6.582
Variables of interest			
Asset to liability ratio	963	1.781	1.238
Teaching (% of income)	963	38.764	14.372
Non-EU students (%)	963	72.797	64.901
Business research contract income (£000)	855	6.646	7.645
F&E contracts revenue (£000)	948	1.644	4.378
Control variables			
University size (employment, log)	969	6.643	1.092
Russell Group – research grants	889	0.634	4.376
University Alliance – research grants	889	0.072	0.219
Million+ – research grants	889	0.033	0.113
Non-aligned – research grants	889	0.395	0.654
Faculty per programme (log)	986	2.322	0.729
Students per programme (log)	986	4.435	0.691
STEM subject programmes (%)	972	35.495	17.306
Single subject programmes (%)	910	53.166	12.649
Major-minor programmes (%)	910	12.076	9.648
Gender diversity of staff	969	0.489	0.014
Ethnic diversity of staff	969	0.168	0.109

Notes and sources: See text for variable definitions and sources of individual variables.
Sources: UCAS, HE-BCI Survey, HESA HEIDI database.

Table 2: Modelling introduction and withdrawal rates: Baseline models

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable (logs)	Introduction rate (ST1)	Withdrawal rate (ST1)	Introduction rate (ST2)	Withdrawal rate (ST2)	Introduction rate (ST3)	Withdrawal rate (ST3)
	b/se	b/se	b/se	b/se	b/se	b/se
Lagged dependent variable (t-1)	-0.104**	-0.050	-0.181***	-0.105***	-0.230***	-0.155***
	(0.041)	(0.039)	(0.040)	(0.040)	(0.039)	(0.040)
Asset to liability ratio (log, t-1)	-0.284**	-0.174	-0.266*	-0.294**	-0.329*	-0.208
	(0.120)	(0.107)	(0.150)	(0.143)	(0.168)	(0.165)
Teaching (%) (log, t-1)	0.269	0.019	0.363	0.179	0.506	0.608*
	(0.264)	(0.235)	(0.329)	(0.312)	(0.369)	(0.362)
Non-EU students (%, log, t-1)	0.141**	0.035	0.127*	0.047	0.128	-0.011
	(0.059)	(0.052)	(0.075)	(0.071)	(0.084)	(0.083)
Business research contracts (log, t-1)	0.044	0.003	0.067	0.024	0.050	0.162
	(0.099)	(0.085)	(0.120)	(0.114)	(0.134)	(0.132)
F&E contract income (log, t-1)	-0.222**	-0.229***	-0.336***	-0.369***	-0.308**	-0.347***
	(0.093)	(0.078)	(0.110)	(0.105)	(0.123)	(0.121)
University size (employment, log, t-1)	-1.311***	0.450	-1.348***	0.735*	-1.751***	0.582
	(0.326)	(0.291)	(0.412)	(0.393)	(0.463)	(0.456)
Russell Group Res. Grants (t-1)	0.021	0.025*	0.016	0.031*	0.018	0.028
	(0.015)	(0.014)	(0.019)	(0.018)	(0.021)	(0.021)
Uni. Alliance Res. Grants (t-1)	-0.060	0.174	-0.190	-0.015	-0.245	-0.054
	(0.341)	(0.304)	(0.433)	(0.412)	(0.486)	(0.478)
Million+ Res. Grants (t-1)	0.493	0.434	0.864**	0.813**	0.760*	0.645
	(0.323)	(0.287)	(0.405)	(0.385)	(0.454)	(0.446)
Non-aligned Res. Grants (t-1)	0.071	0.093	-0.017	-0.067	0.025	-0.127
	(0.106)	(0.094)	(0.132)	(0.126)	(0.148)	(0.146)
Faculty per programme (log, t-1)	1.421***	-0.793**	1.275***	-1.227***	1.610***	-1.071**
	(0.380)	(0.335)	(0.474)	(0.451)	(0.532)	(0.523)
Students per programme (log t-1)	-0.222	-0.388	-0.404	-0.124	-0.579	-0.205
	(0.349)	(0.282)	(0.398)	(0.379)	(0.447)	(0.439)
SEM programmes (%,t-1)	-0.012*	-0.005	-0.009	0.004	-0.010	0.007
	(0.007)	(0.006)	(0.009)	(0.008)	(0.010)	(0.010)
Single subject programmes (%,t-1)	-0.010	-0.007	-0.006	0.006	-0.001	0.008
	(0.006)	(0.006)	(0.008)	(0.008)	(0.009)	(0.009)
Major-minor programmes (%,t-1)	0.008	0.026***	0.015**	0.025***	0.013*	0.021***
	(0.005)	(0.004)	(0.006)	(0.006)	(0.007)	(0.007)
Gender diversity index (t-1)	1.448	1.364	4.338	2.464	7.065	8.607
	(6.703)	(5.942)	(8.471)	(8.052)	(9.504)	(9.334)
Ethnic diversity index (t-1)	-3.536***	-2.846**	-4.747***	-3.573**	-4.082**	-3.430*
	(1.368)	(1.218)	(1.726)	(1.640)	(1.935)	(1.902)
No. of observations	786	787	777	777	777	777
p	0.000	0.000	0.000	0.000	0.000	0.000
BIC	1060.971	880.355	1391.039	1312.687	1570.045	1542.205

Notes and Sources: See text for variable definitions and sources. Panel regression with fixed effects. Marginal effects are reported. All models include year dummies. * denotes p<0.10; ** p<0.05 and *** p<0.01.

Table 3: Modelling introduction and withdrawal rates: Baseline models with longer lags

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable (logs)	Introduction rate (ST1)	Withdrawal rate (ST1)	Introduction rate (ST2)	Withdrawal rate (ST2)	Introduction rate (ST3)	Withdrawal rate (ST3)
Lagged dependent variable (t-2)	-0.027	-0.011	-0.138***	-0.081**	-0.197***	-0.147***
	(0.039)	(0.036)	(0.039)	(0.040)	(0.038)	(0.040)
Asset to liability ratio (log, t-2)	0.037	0.171	0.085	0.199	-0.042	0.197
	(0.118)	(0.104)	(0.152)	(0.147)	(0.171)	(0.170)
Teaching (%) (log, t-2)	0.159	0.058	0.227	0.097	0.129	0.093
	(0.245)	(0.218)	(0.314)	(0.304)	(0.354)	(0.352)
Non-EU students (%, log, t-2)	0.085	0.035	0.113	0.052	0.153*	0.069
	(0.057)	(0.051)	(0.074)	(0.072)	(0.083)	(0.083)
Business research contracts (log, t-2)	0.071	0.162**	0.114	0.180*	0.107	0.105
	(0.084)	(0.074)	(0.106)	(0.103)	(0.119)	(0.119)
F&E contract income (log, t-2)	-0.160*	-0.268***	-0.245**	-0.362***	-0.278**	-0.249**
	(0.084)	(0.074)	(0.107)	(0.104)	(0.120)	(0.120)
University size (employment, log, t-1)	-1.287***	0.435	-1.339***	0.758*	-1.719***	0.590
	(0.311)	(0.276)	(0.408)	(0.396)	(0.460)	(0.459)
Russell Group Res. Grants (t-1)	0.027*	0.031**	0.024	0.038**	0.027	0.037*
	(0.014)	(0.013)	(0.018)	(0.018)	(0.021)	(0.020)
Uni. Alliance Res. Grants (t-1)	0.079	0.133	0.043	-0.032	0.021	-0.044
	(0.322)	(0.285)	(0.426)	(0.412)	(0.479)	(0.477)
Million+ Res. Grants (t-1)	0.426	0.324	0.751*	0.681*	0.616	0.500
	(0.308)	(0.272)	(0.401)	(0.388)	(0.451)	(0.449)
Non-aligned Res. Grants (t-1)	-0.085	-0.068	-0.147	-0.194	-0.107	-0.256*
	(0.104)	(0.092)	(0.132)	(0.128)	(0.149)	(0.148)
Faculty per programme (log, t-1)	1.704***	-0.614*	1.488***	-1.102**	1.905***	-0.971*
	(0.361)	(0.319)	(0.469)	(0.454)	(0.528)	(0.526)
Students per programme (log t-1)	-0.018	-0.151	-0.259	0.145	-0.492	0.374
	(0.328)	(0.289)	(0.429)	(0.416)	(0.483)	(0.480)
SEM programmes (%,t-1)	-0.006	-0.002	-0.003	0.006	-0.004	0.010
	(0.007)	(0.006)	(0.009)	(0.008)	(0.010)	(0.010)
Single subject programmes (%,t-1)	-0.016***	-0.013**	-0.009	0.003	-0.003	0.005
	(0.006)	(0.005)	(0.008)	(0.008)	(0.009)	(0.009)
Major-minor programmes (%,t-1)	-0.007	0.014***	-0.002	0.014**	-0.005	0.009
	(0.005)	(0.005)	(0.007)	(0.006)	(0.008)	(0.008)
Gender diversity index (t-1)	0.343	0.517	5.363	3.000	6.017	9.688
	(6.238)	(5.517)	(8.340)	(8.062)	(9.382)	(9.335)
Ethnic diversity index (t-1)	-2.993**	-2.396**	-4.133**	-3.156**	-3.571*	-2.587
	(1.275)	(1.129)	(1.660)	(1.605)	(1.866)	(1.858)
No. of observations	785	785	766	766	766	766
p	0.000	0.000	0.000	0.000	0.000	0.000
BIC	980.128	791.001	1319.868	1270.178	1500.757	1494.725

Notes and Sources: See text for variable definitions and sources. Panel regression with fixed effects. Marginal effects are reported. All models include year dummies. * denotes p<0.10; ** p<0.05 and *** p<0.01.

Table 4: Modelling introduction and withdrawal rates: Finance by mission group

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable (logs)	Introduction rate (ST1)	Withdrawal rate (ST1)	Introduction rate (ST2)	Withdrawal rate (ST2)	Introduction rate (ST3)	Withdrawal rate (ST3)
Lagged dependent variable (-1)	-0.107***	-0.053	-0.183***	-0.107***	-0.231***	-0.157***
	(0.041)	(0.039)	(0.040)	(0.040)	(0.039)	(0.040)
Asset to liab ratio – Russ. Group (-1)	0.063	0.299	-0.086	-0.143	-0.011	-0.123
	(0.366)	(0.326)	(0.459)	(0.436)	(0.515)	(0.505)
Asset to liab ratio – U.Alliance (-1)	-0.466*	-0.108	-0.212	0.050	-0.270	0.173
	(0.242)	(0.215)	(0.302)	(0.287)	(0.338)	(0.332)
Asset to liab ratio – Million+ (-1)	-0.555**	-0.166	-0.701*	-0.611*	-0.815**	-0.568
	(0.280)	(0.249)	(0.360)	(0.341)	(0.403)	(0.396)
Asset to liab ratio – Non A. (-1)	-0.209	-0.291**	-0.203	-0.365**	-0.281	-0.269
	(0.155)	(0.138)	(0.194)	(0.184)	(0.217)	(0.214)
Teaching (%) (log, t-1)	0.274	0.031	0.370	0.188	0.516	0.616*
	(0.264)	(0.235)	(0.329)	(0.313)	(0.369)	(0.363)
Non-EU students (%, log, t-1)	0.134**	0.037	0.119	0.046	0.119	-0.013
	(0.059)	(0.053)	(0.075)	(0.072)	(0.084)	(0.083)
Business research contracts (log, t-1)	0.041	0.003	0.073	0.035	0.057	0.175
	(0.099)	(0.085)	(0.120)	(0.114)	(0.135)	(0.132)
F&E contract income (log, t-1)	-0.228**	-0.222***	-0.346***	-0.372***	-0.317**	-0.350***
	(0.093)	(0.078)	(0.111)	(0.105)	(0.124)	(0.122)
University size (employment, log, t-1)	-1.298***	0.487*	-1.370***	0.712*	-1.764***	0.547
	(0.328)	(0.292)	(0.416)	(0.395)	(0.467)	(0.459)
Russell Group Res. Grants (t-1)	0.020	0.024*	0.015	0.031*	0.017	0.028
	(0.015)	(0.014)	(0.019)	(0.018)	(0.021)	(0.021)
Uni. Alliance Res. Grants (t-1)	-0.035	0.154	-0.195	-0.065	-0.252	-0.108
	(0.342)	(0.305)	(0.435)	(0.414)	(0.488)	(0.480)
Million+ Res. Grants (t-1)	0.481	0.432	0.855**	0.812**	0.748	0.645
	(0.323)	(0.287)	(0.405)	(0.385)	(0.454)	(0.446)
Non-aligned Res. Grants (t-1)	0.068	0.090	-0.017	-0.064	0.024	-0.124
	(0.106)	(0.094)	(0.132)	(0.126)	(0.148)	(0.146)
Faculty per programme (log, t-1)	1.404***	-0.845**	1.271***	-1.243***	1.592***	-1.078**
	(0.382)	(0.337)	(0.477)	(0.454)	(0.535)	(0.526)
Students per programme (log t-1)	-0.230	-0.349	-0.441	-0.150	-0.609	-0.244
	(0.351)	(0.284)	(0.402)	(0.383)	(0.451)	(0.443)
SEM programmes (%,t-1)	-0.011	-0.005	-0.009	0.003	-0.010	0.007
	(0.007)	(0.006)	(0.009)	(0.008)	(0.010)	(0.010)
Single subject programmes (%,t-1)	-0.011	-0.007	-0.006	0.008	-0.001	0.010
	(0.006)	(0.006)	(0.008)	(0.008)	(0.009)	(0.009)
Major-minor programmes (%,t-1)	0.008	0.027***	0.015**	0.025***	0.013*	0.021***
	(0.005)	(0.004)	(0.006)	(0.006)	(0.007)	(0.007)
Gender diversity index (t-1)	1.264	1.489	3.808	1.976	6.495	8.046
	(6.710)	(5.946)	(8.490)	(8.064)	(9.524)	(9.350)
Ethnic diversity index (t-1)	-3.321**	-2.773**	-4.712***	-3.744**	-4.007**	-3.643*
	(1.380)	(1.227)	(1.743)	(1.655)	(1.954)	(1.920)
No. of observations	786	787	777	777	777	777
p	0.000	0.000	0.000	0.000	0.000	0.000
BIC	1077.653	896.663	1408.761	1329.252	1587.579	1559.205

Notes and Sources: See text for variable definitions and sources. Panel regression with fixed effects. Marginal effects are reported. All models include year dummies. * denotes p<0.10; ** p<0.05 and *** p<0.01.

Table 5: Modelling introduction and withdrawal rates: Non-EU students by mission group

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable (logs)	Introduction rate (ST1)	Withdrawal rate (ST1)	Introduction rate (ST2)	Withdrawal rate (ST2)	Introduction rate (ST3)	Withdrawal rate (ST3)
Lagged dependent variable (t-1)	-0.107***	-0.053	-0.182***	-0.107***	-0.231***	-0.156***
	(0.041)	(0.039)	(0.040)	(0.040)	(0.039)	(0.040)
Asset to liability ratio (log, t-1)	-0.280**	-0.171	-0.268*	-0.307**	-0.326*	-0.225
	(0.120)	(0.107)	(0.151)	(0.143)	(0.169)	(0.166)
Teaching (%) (log, t-1)	0.227	-0.003	0.358	0.170	0.508	0.611*
	(0.264)	(0.235)	(0.330)	(0.314)	(0.370)	(0.363)
Russell Group Non-EU students (t-1)	0.342*	0.171	0.128	-0.089	0.202	-0.243
	(0.204)	(0.182)	(0.256)	(0.243)	(0.287)	(0.281)
Uni. Alliance Non-EU students (t-1)	-0.089	-0.074	0.051	-0.062	0.064	-0.071
	(0.118)	(0.105)	(0.156)	(0.148)	(0.175)	(0.172)
Million+ Non-EU students (t-1)	0.210*	0.095	0.060	0.035	-0.048	-0.063
	(0.119)	(0.106)	(0.151)	(0.143)	(0.169)	(0.166)
Non-aligned Non-EU students (t-1)	0.195**	0.039	0.202*	0.134	0.243**	0.090
	(0.088)	(0.078)	(0.110)	(0.105)	(0.124)	(0.122)
Business research contracts (log, t-1)	0.031	-0.005	0.067	0.029	0.049	0.172
	(0.099)	(0.086)	(0.120)	(0.114)	(0.135)	(0.132)
F&E contract income (log, t-1)	-0.223**	-0.229***	-0.339***	-0.375***	-0.310**	-0.354***
	(0.092)	(0.078)	(0.110)	(0.105)	(0.124)	(0.121)
University size (employment, log, t-1)	-1.300***	0.460	-1.351***	0.708*	-1.745***	0.539
	(0.327)	(0.292)	(0.415)	(0.395)	(0.466)	(0.458)
Russell Group Res. Grants (t-1)	0.022	0.026*	0.016	0.030*	0.019	0.027
	(0.015)	(0.014)	(0.019)	(0.018)	(0.021)	(0.021)
Uni. Alliance Res. Grants (t-1)	-0.075	0.165	-0.181	-0.009	-0.230	-0.049
	(0.341)	(0.304)	(0.434)	(0.413)	(0.487)	(0.478)
Million+ Res. Grants (t-1)	0.515	0.452	0.851**	0.808**	0.729	0.631
	(0.323)	(0.288)	(0.406)	(0.386)	(0.455)	(0.447)
Non-aligned Res. Grants (t-1)	0.074	0.093	-0.014	-0.068	0.032	-0.129
	(0.106)	(0.095)	(0.132)	(0.126)	(0.149)	(0.146)
Faculty per programme (log, t-1)	1.344***	-0.835**	1.252***	-1.220***	1.562***	-1.038*
	(0.383)	(0.338)	(0.479)	(0.456)	(0.537)	(0.529)
Students per programme (log t-1)	-0.168	-0.356	-0.379	-0.111	-0.539	-0.212
	(0.350)	(0.284)	(0.402)	(0.383)	(0.451)	(0.443)
SEM programmes (%,t-1)	-0.011	-0.005	-0.010	0.004	-0.011	0.007
	(0.007)	(0.006)	(0.009)	(0.008)	(0.010)	(0.010)
Single subject programmes (%,t-1)	-0.009	-0.006	-0.007	0.006	-0.002	0.007
	(0.006)	(0.006)	(0.008)	(0.008)	(0.009)	(0.009)
Major-minor programmes (%,t-1)	0.008*	0.027***	0.015**	0.025***	0.013*	0.021***
	(0.005)	(0.004)	(0.006)	(0.006)	(0.007)	(0.007)
Gender diversity index (t-1)	2.498	1.908	4.353	2.665	6.795	8.576
	(6.708)	(5.963)	(8.502)	(8.076)	(9.529)	(9.361)
Ethnic diversity index (t-1)	-3.591***	-2.832**	-4.850***	-3.649**	-4.304**	-3.562*
	(1.371)	(1.223)	(1.735)	(1.648)	(1.944)	(1.911)
No. of observations	786	787	777	777	777	777
p	0.000	0.000	0.000	0.000	0.000	0.000
BIC	1074.291	897.939	1409.890	1330.668	1587.397	1560.103

Notes and Sources: See text for variable definitions and sources. Panel regression with fixed effects. Marginal effects are reported. All models include year dummies. * denotes p<0.10; ** p<0.05 and *** p<0.01.

Table 6: Modelling introduction and withdrawal rates: External engagement effects by mission group

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable (logs)	Introduction rate (ST1)	Withdrawal rate (ST1)	Introduction rate (ST2)	Withdrawal rate (ST2)	Introduction rate (ST3)	Withdrawal rate (ST3)
Lagged dependent variable (-1)	-0.102**	-0.054	-0.184***	-0.107***	-0.232***	-0.157***
	(0.041)	(0.039)	(0.040)	(0.040)	(0.039)	(0.040)
Lagged dependent variable (t-1)	-0.290**	-0.182*	-0.268*	-0.303**	-0.335**	-0.218
	(0.121)	(0.107)	(0.152)	(0.144)	(0.170)	(0.167)
Asset to liability ratio (log, t-1)	0.263	-0.080	0.394	0.085	0.531	0.513
	(0.268)	(0.238)	(0.335)	(0.318)	(0.376)	(0.368)
Teaching (%) (log, t-1)	0.138**	0.038	0.127*	0.049	0.129	-0.008
	(0.059)	(0.052)	(0.075)	(0.071)	(0.084)	(0.083)
Russell Group Bus. Res. Conts. (t-1)	0.045	0.140	-0.083	0.217	-0.194	0.257
	(0.249)	(0.222)	(0.311)	(0.295)	(0.349)	(0.342)
Uni. Alliance Bus. Res. Conts. (t-1)	-0.026	0.335	0.103	0.240	0.086	0.341
	(0.330)	(0.293)	(0.421)	(0.399)	(0.472)	(0.463)
Million+ Bus. Res. Conts. (t-1)	-0.192	-0.676**	0.253	-0.606	0.203	-0.459
	(0.348)	(0.309)	(0.435)	(0.413)	(0.488)	(0.479)
Non-aligned Bus. Res. Conts. (t-1)	0.086	0.008	0.077	0.021	0.083	0.177
	(0.120)	(0.100)	(0.140)	(0.133)	(0.157)	(0.154)
Russell Group F&E contracts (t-1)	-0.151	-0.311	-0.347	-0.618**	-0.372	-0.673**
	(0.247)	(0.220)	(0.309)	(0.294)	(0.346)	(0.340)
Uni. Alliance F&E contracts (t-1)	-0.433	-0.048	-0.399	-0.426	-0.355	-0.555
	(0.298)	(0.264)	(0.380)	(0.361)	(0.426)	(0.418)
Million+ F&E contracts (t-1)	0.767	-0.301	0.410	-0.671	0.438	-0.899
	(0.539)	(0.479)	(0.674)	(0.639)	(0.756)	(0.741)
Non-aligned F&E contracts (t-1)	-0.269**	-0.244***	-0.352***	-0.324***	-0.317**	-0.265*
	(0.109)	(0.089)	(0.126)	(0.119)	(0.141)	(0.138)
University size (employment, log, t-1)	-1.257***	0.501*	-1.333***	0.777**	-1.739***	0.608
	(0.329)	(0.292)	(0.417)	(0.396)	(0.468)	(0.459)
Russell Group Res. Grants (t-1)	0.021	0.025*	0.016	0.030*	0.018	0.027
	(0.015)	(0.014)	(0.019)	(0.018)	(0.021)	(0.021)
Uni. Alliance Res. Grants (t-1)	-0.018	0.082	-0.191	-0.053	-0.247	-0.068
	(0.350)	(0.311)	(0.445)	(0.422)	(0.499)	(0.490)
Million+ Res. Grants (t-1)	0.548*	0.585**	0.828**	0.947**	0.732	0.777*
	(0.331)	(0.294)	(0.416)	(0.395)	(0.466)	(0.458)
Non-aligned Res. Grants (t-1)	0.067	0.091	-0.017	-0.070	0.023	-0.133
	(0.106)	(0.094)	(0.133)	(0.126)	(0.149)	(0.146)
Faculty per programme (log, t-1)	1.303***	-0.892***	1.241**	-1.290***	1.577***	-1.106**
	(0.386)	(0.340)	(0.482)	(0.458)	(0.541)	(0.531)
Students per programme (log t-1)	-0.054	-0.322	-0.372	-0.060	-0.555	-0.161
	(0.359)	(0.288)	(0.407)	(0.387)	(0.457)	(0.448)
SEM programmes (%,t-1)	-0.012	-0.004	-0.009	0.004	-0.010	0.007
	(0.007)	(0.006)	(0.009)	(0.008)	(0.010)	(0.010)
Single subject programmes (%,t-1)	-0.013*	-0.007	-0.007	0.006	-0.002	0.008
	(0.007)	(0.006)	(0.008)	(0.008)	(0.009)	(0.009)
Major-minor programmes (%,t-1)	0.007	0.027***	0.014**	0.025***	0.013*	0.021***
	(0.005)	(0.004)	(0.006)	(0.006)	(0.007)	(0.007)
Gender diversity index (t-1)	1.733	1.339	4.495	1.372	6.969	6.737
	(6.782)	(5.994)	(8.574)	(8.136)	(9.620)	(9.431)

Ethnic diversity index (t-1)	-3.498**	-2.873**	-4.723***	-3.446**	-4.023**	-3.199*
	(1.380)	(1.225)	(1.740)	(1.650)	(1.951)	(1.913)
No. of observations	786	787	777	777	777	777
p	0.000	0.000	0.000	0.000	0.000	0.000
BIC	1095.307	911.687	1428.907	1347.732	1607.861	1577.283

Notes and Sources: See text for variable definitions and sources. Panel regression with fixed effects. Marginal effects are reported. All models include year dummies. * denotes p<0.10; ** p<0.05 and *** p<0.01.

Annex 1: Illustrative list of programme introductions and withdrawals: University of Warwick

	Introduced	**Withdrawn**
2007	Biomedical Science German with Italian (4 yrs inc. year abroad) German with Spanish Italian with French (4 yrs inc. year abroad) Law (4 Years) - Study Abroad in English Mathematics with Computing	French Studies with German (4 yrs inc. year abroad) German with French (4 yrs inc. year abroad) Law (4 years)
2008	Discrete Mathematics History, Literature and Cultures of the Americas	Comparative American Studies (4 yrs inc. year abroad) German Studies and Italian (4 yrs inc. year abroad) German with Italian (4 yrs inc. year abroad) German with Spanish Italian with French (4 yrs inc. year abroad) Physics and Business Studies
2009	Economics and Industrial Organisation French with Theatre Studies International Management Medicine MBChB - Graduate Entry	English and American Literature Industrial Economics Mathematics with Computing Medicine MBChB
2010	Environmental Biology Film Studies	Computer and Management Sciences Italian Mathematics and Business Studies Philosophy with Classical Civilisation Politics with French (4 yrs inc. year abroad)
2011	International Management (including year abroad) Italian and Classics Law (with Study Abroad in English) Law and Business Studies Law and Sociology	Computer and Information Engineering Computing Systems Environmental Biology French with Theatre Studies History and Culture History of Art and French Studies International Management Law (4 Years) - Study Abroad in English Law and Business Studies (3/4 years) Law and Sociology (4 years) Systems Engineering
2012	Childhood, Education and Society Computing Systems German and History History and Italian (Including Year Abroad)	Classical Civilisation with Philosophy Early Childhood Studies Economics and Economic History English and Italian Literature (4 yrs inc. year abroad) Film with Television Studies Italian and Classics
2013	Classical Civilisation (with Study in Europe) French with Spanish Hispanic Studies and French Law with Humanities Law with Social Sciences Medicine Graduate Entry	Biomedical Chemistry Chemical Biology English and Latin Literature German and History German with Spanish (4 yrs inc. year abroad) Manufacturing and Mechanical Engineer Medicine MBChB - Graduate Entry Philosophy with Psychology

Annex 2: Correlation Matrix (N=786)

	|	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	ST1 – per cent of programmes (%)	1.00																						
2	ST2 – per cent of students (%)	0.80	1.00																					
3	ST3 – per cent of students (%)	0.74	0.95	1.00																				
4	ST1 - Withdrawal rate (%)	0.54	0.67	0.59	1.00																			
5	ST2 – per cent of students (%)	0.55	0.75	0.68	0.86	1.00																		
6	ST3 – per cent of students (%)	0.52	0.73	0.69	0.77	0.93	1.00																	
7	Asset to liability ratio	0.02	0.01	0.02	-0.01	0.03	0.06	1.00																
8	Teaching (% of income)	0.18	0.11	0.12	0.22	0.18	0.19	0.19	1.00															
9	Non-EU students (%)	-0.14	-0.18	-0.17	-0.17	-0.16	-0.12	-0.19	-0.12	1.00														
10	Business research contract income (£000)	-0.11	-0.06	0.07	-0.11	-0.06	-0.05	-0.13	-0.34	0.14	1.00													
11	F&E contracts revenue (£000)	-0.09	-0.07	-0.05	-0.10	-0.08	-0.05	-0.10	-0.11	0.03	0.36	1.00												
12	University size (employment, log)	-0.22	-0.26	-0.22	-0.17	-0.21	-0.13	-0.25	-0.13	0.45	-0.04	-0.09	1.00											
13	Russell Group – research grants	0.12	0.11	0.10	0.10	0.08	0.07	0.22	0.17	-0.45	0.09	0.41	-0.56	1.00										
14	University Alliance – research grants	0.00	-0.02	0.00	-0.01	-0.02	-0.01	0.11	-0.16	0.00	0.07	0.00	0.11	-0.10	1.00									
15	Million+ – research grants	-0.02	-0.03	0.00	0.02	-0.01	0.03	0.09	0.21	-0.16	-0.11	-0.07	0.13	0.11	-0.05	1.00								
16	Non-aligned – research grants	0.09	0.07	0.07	0.09	0.06	0.03	0.05	0.11	-0.15	-0.09	-0.09	-0.15	0.16	-0.04	-0.10	1.00							
17	Faculty per programme (log)	0.00	-0.03	-0.04	0.00	0.00	-0.01	-0.13	-0.12	0.10	0.06	0.12	-0.10	-0.03	-0.09	-0.21	-0.18	1.00						
18	Students per programme (log)	-0.27	-0.27	-0.22	-0.23	-0.20	-0.11	-0.18	-0.27	0.62	0.10	-0.07	0.71	-0.64	0.12	-0.12	-0.19	0.03	1.00					
19	STEM subject programmes (%)	-0.24	-0.18	-0.08	-0.16	-0.11	-0.01	0.00	-0.14	0.09	0.20	-0.03	0.35	-0.15	0.15	0.07	-0.04	-0.20	0.62	1.00				
20	Single subject programmes (%)	-0.21	-0.15	-0.11	-0.11	-0.09	-0.02	-0.23	-0.27	0.22	0.23	0.15	0.40	-0.20	0.06	0.04	-0.03	-0.06	0.28	0.22	1.00			
21	Major-minor programmes (%)	-0.06	-0.05	0.02	-0.01	-0.02	0.04	-0.02	0.13	-0.06	0.02	0.06	-0.01	0.19	-0.03	0.11	0.14	-0.07	0.06	0.35	0.11	1.00		
22	Gender diversity of staff	-0.02	-0.04	-0.06	-0.07	-0.06	-0.07	0.21	-0.18	0.11	0.06	-0.01	0.07	-0.10	0.08	0.05	-0.02	-0.01	0.05	-0.09	0.18	-0.35	1.00	
23	Ethnic diversity of staff	0.02	0.01	-0.01	0.04	0.02	0.01	-0.08	0.13	-0.14	-0.20	-0.04	0.14	-0.12	-0.12	0.07	-0.04	0.12	-0.05	-0.20	-0.04	-0.18	0.00	1.00

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